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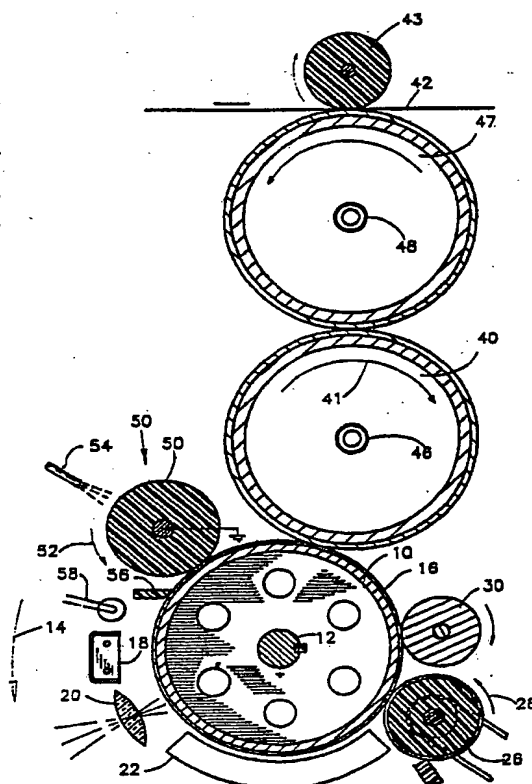
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(21) International Application Number: PCT/NL90/00182 (22) International Filing Date: 13 December 1990 (13.12.90) (60) Parent Applications or Grants (63) Related by Continuation US 293,456 (CIP) Filed on 4 January 1989 (04.01.89) US 446,877 (CIP) Filed on 6 December 1989 (06.12.89) (71) Applicant (for all designated States except US): SPECTRUM SCIENCES B.V. [NL/NL]; Zijdweg 6, NL-2244 BG Wassenaar (NL). (72) Inventors; and (75) Inventors/Applicants (for US only): LIOR, Ishaiau [IL/IL]; 21, Bilu Street, 70 400 Ness Ziona (IL). LANDA, Benzion [CA/CA]; 10010-119 Street, Edmonton, Alberta T5K 1Y8 (CA). LAVON, Amiran [IL/IL]; 143/5, Balfour Street, 59 576 Bat Yam (IL). PINHAS, Hanna [IL/IL]; 20, Shprinzak Street, 58 331 Holon (IL).		(74) Agent: DE BRUIJN, Leendert, C.; Nederlandsch Octrooibureau, Scheveningseweg 82, NL-2502 LS The Hague (NL). (81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), US. Published With international search report.	

(54) Title: IMAGING SYSTEM WITH INTERMEDIATE TRANSFER MEMBER

(57) Abstract

Imaging apparatus for printing an image on a substrate (42) from a latent image formed on a latent image bearing surface (16) including: developing apparatus (22) for developing the latent image with a liquid developer to form a developed liquid toner image; a first intermediate transfer member (4); first transfer apparatus for transferring the developed image from the latent image bearing surface (16) to the first intermediate transfer member (40) at a first transfer region; a second intermediate transfer member (47); second transfer means for transferring the developed image from the first image transfer member (40) to the second intermediate transfer member (47) at a second transfer region; and third transfer apparatus for transferring the developed image from the second intermediate (47) transfer member to the substrate (42).



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1 IMAGING SYSTEM WITH INTERMEDIATE TRANSFER MEMBER

2 FIELD OF THE INVENTION

3 The present invention relates to image transfer
4 techniques and apparatus for use in electrophotography.

5 BACKGROUND OF THE INVENTION

6 Various prior publications deal with the transfer of
7 single and multiple powder and liquid toner images from a
8 photoreceptor on which they are formed to an intermediate
9 transfer member for subsequent transfer to a final substrate.

10 U. S. Patent 3,838,919 to Takahashi describes a powder
11 toner system in which color toner images are sequentially
12 formed on an image forming member, individually transferred
13 to an intermediate transfer member and transferred at one
14 time to a recording member.

15 U. S. Patent 4,144,808 to Isawa et al. describes a
16 method of printing on a metal plate utilizing powder toner
17 and an intermediate transfer member where the plate is
18 heated before transfer.

19 U. S. Patent 4,518,976 to Tarumi et al. describes a
20 monochrome powder toner system in which a powder image is
21 developed on a photoreceptor, and transferred
22 electrostatically to an intermediate transfer member.
23 Downstream this transfer, the intermediate transfer member
24 and the image thereon are heated before transfer to a
25 preheated substrate.

26 U. S. Patent 4,515,460 to Knechtel, describes a powder
27 toner apparatus wherein separate toner images are
28 sequentially developed on a photoreceptor and
29 electrostatically transferred to an intermediate transfer
30 member. After all of the individual images have been
31 transferred to the intermediate transfer member, they are
32 transferred electrostatically to the final substrate. No
33 heating of the images or substrate is disclosed.

34 U. S. Patent 4,585,319 to Okamoto et al. describes a
35 powder developer type, single color system, utilizing a
36 temperature controlled photoreceptor, a heated intermediate
37 transfer member and a heated transfer fixing roller which is
38 heated to a temperature slightly higher than that of the

1 intermediate transfer member.

2 U. S. Patent 4,690,539 to Radulski et al. describes a
3 liquid toner multi-color system in which a color image is
4 developed on a photoreceptor and transferred to a belt type
5 intermediate transfer member. The liquid carrier is removed
6 from the toner image on the belt. There is no mention of
7 heating the intermediate transfer member or of the problem of
8 back transfer.

9 U. S. Patent 4,708,460 to Langdon describes a single
10 color liquid toner system in which a developed image is
11 transferred from a photoreceptor to an intermediate transfer
12 member, heated on the transfer member and then transferred to
13 a final substrate.

14 U. S. Patent 3,847,478 to Young describes a duplex
15 printing system, wherein a developed image is transferred
16 from a photoconductor to an intermediate transfer member, a
17 second image is developed on the photoconductor and both
18 images are transferred electrostatically to opposite sides of
19 a piece of paper passed between the intermediate transfer
20 member and the photoreceptor.

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SUMMARY OF THE INVENTION

2 The present invention seeks to provide improved
3 apparatus for image transfer.

4 It is an object of the present invention to provide a
5 method and apparatus for the improved transfer of an image
6 from an image bearing surface to an intermediate transfer
7 member.

8 It is a further object of the present invention to
9 provide a method and apparatus for the improved transfer of
10 an image from an image bearing surface to an intermediate
11 transfer member and subsequent transfer to a final substrate.

12 It is a further object of the present invention to
13 provide a method and apparatus for the sequential transfer of
14 a plurality of superimposed images to an intermediate
15 transfer layer without back transfer.

16 There is thus provided in accordance with a preferred
17 embodiment of the invention imaging apparatus for printing an
18 image on a substrate from a latent image formed on a latent
19 image bearing surface including:

20 developing apparatus for developing the latent image with
21 a liquid developer to form a developed liquid toner image;

22 a first intermediate transfer member;

23 first transfer apparatus for transferring the developed
24 image from the latent image bearing surface to the first
25 intermediate transfer member at a first transfer region;

26 a second intermediate transfer member:

27 second transfer apparatus for transferring the developed
28 image from the first image transfer member to the second
29 intermediate transfer member at a second transfer region; and

30 third transfer apparatus for transferring the developed
31 image from the second intermediate transfer member to the
32 substrate.

33 In a preferred embodiment of the invention the imaging
34 apparatus includes heating apparatus for heating the
35 developed liquid toner image to a first temperature higher
36 than room temperature at the first transfer region and to a
37 second temperature higher than the first temperature at the
38 second transfer region.

1 In a preferred embodiment of the invention the imaging
2 apparatus includes intermediate transfer member heating
3 apparatus for heating the first intermediate transfer member
4 to a first temperature and for heating the second
5 intermediate transfer member to a second temperature higher
6 than the first temperature.

7 In a further preferred embodiment of the invention liquid
8 toner image transfer from the image bearing surface is
9 enhanced at temperatures above a first given temperature;

10 liquid toner image transfer to the final substrate is
11 enhanced at temperatures above a second given temperature,
12 higher than the first given temperature; and

13 undesirable image transfer from the intermediate transfer
14 member to the image bearing surface is increased at
15 temperatures above a third given temperature, higher than the
16 first given temperature and lower than the second given
17 temperature, and

18 the first temperature is above the first given
19 temperature and below the third given temperature, and
20 wherein the second temperature is above the second given
21 temperature.

22 In a preferred embodiment of the invention the imaging
23 apparatus also includes first voltage apparatus for
24 maintaining the first intermediate transfer member at a first
25 voltage. Preferably at least a portion of the latent image
26 bearing surface is at a second voltage and the first voltage
27 is different from the second voltage. Preferably the
28 apparatus also includes second voltage apparatus for
29 maintaining the second intermediate transfer member at a
30 third voltage.

31 In a preferred embodiment of the invention the developing
32 apparatus is operative for developing a latent image to form
33 a second developed liquid toner image thereon after transfer
34 of the developed liquid toner image therefrom to the
35 intermediate transfer member and the first transfer apparatus
36 is operative to transfer the second liquid toner image to the
37 first intermediate transfer member, without substantial back-
38 transfer of the first image to the image bearing member, to

1 form a composite image. Preferably the second transfer
2 apparatus is operative to transfer the composite image to the
3 second intermediate transfer member.

4 In a preferred embodiment of the invention the developing
5 apparatus is operative to develop a different latent image to
6 form a different liquid toner image on the image bearing
7 surface; and the first transfer apparatus is operative to
8 transfer the different liquid toner image to the first
9 intermediate transfer member subsequent to transfer of the
10 developed liquid toner image therefrom to the second image
11 transfer member. Preferably the third transfer apparatus the
12 third transfer apparatus includes apparatus for supplying a
13 substrate to the second transfer region; and apparatus for
14 urging the first and second transfer members against each
15 other whereby the developed liquid toner image is transferred
16 to one side of the substrate and the different liquid toner
17 image is transferred to the other side of the substrate.

18 There is further provided in a preferred embodiment of
19 the invention imaging apparatus for printing an image from a
20 latent image formed on a latent image bearing surface
21 including:

22 developing apparatus for developing the latent image
23 with a liquid developer to form a developed liquid toner
24 image;

25 a heated intermediate transfer member for receiving the
26 developed image from the latent image bearing surface at a
27 first transfer region, for subsequent transfer to a final
28 substrate at a second transfer region; and

29 cooling apparatus for cooling a portion of the
30 intermediate transfer member prior to transfer of a portion
31 of the developed image to the cooled portion of the
32 intermediate transfer member.

33 In a preferred embodiment of the invention liquid toner
34 image transfer from the image bearing surface is enhanced at
35 temperatures above a first given temperature; liquid toner
36 image transfer to the final substrate is enhanced at
37 temperatures above a second given temperature, higher than
38 the first given temperature; and undesirable image transfer

1 from the intermediate transfer member to the image bearing
2 surface is increased at temperatures above a third given
3 temperature, higher than the first given temperature and
4 lower than the second given temperature, and wherein the
5 intermediate transfer member is heated to a temperature above
6 the second temperature at the second transfer region and the
7 cooling apparatus is operative to cool the intermediate
8 transfer member to a temperature above the first temperature
9 and below the third temperature at the first transfer region.

10 In a preferred embodiment of the invention the developing
11 apparatus is operative for developing a latent image to form
12 a second developed liquid toner image thereon after transfer
13 of the developed liquid toner image therefrom to the
14 intermediate transfer member; and the intermediate transfer
15 member and the cooling apparatus are operative to transfer
16 the second developed liquid toner image to the intermediate
17 transfer member, without substantial back-transfer of the
18 first liquid toner image to the image bearing member, to form
19 a composite image.

20 There is further provided in a preferred embodiment of
21 the invention imaging apparatus for printing an image on a
22 substrate from a latent image formed on a latent image
23 bearing surface including:

24 developing apparatus for developing the latent image with
25 a liquid developer to form a developed liquid toner image;

26 an intermediate transfer member heated to a first
27 temperature;

28 first transfer apparatus for transferring the developed
29 image from the latent image bearing surface to the
30 intermediate transfer member at a first transfer region;

31 second transfer apparatus for transferring the developed
32 image from the intermediate transfer member to the substrate
33 the second transfer apparatus including:

34 apparatus for heating the substrate to a second
35 temperature higher than the first temperature.

36 In a preferred embodiment of the invention the apparatus
37 for heating comprises a heating backing roller operative to
38 apply heat and pressure to the image during the second

1 transfer.

2 In a preferred embodiment of the invention the developing
3 apparatus is operative for developing a latent image to form
4 a second developed liquid toner image thereon after transfer
5 of the developed liquid toner image therefrom to the
6 intermediate transfer member; and

7 the first transfer apparatus is operative to transfer the
8 second developed liquid toner image to the intermediate
9 transfer member, without substantial back-transfer of the
10 developed liquid toner image to the image bearing member, to
11 form a composite image.

12 BRIEF DESCRIPTION OF THE DRAWINGS

13 The present invention will be understood and appreciated
14 more fully from the following detailed description, taken in
15 conjunction with the drawings in which:

16 Fig. 1 is a simplified sectional illustration of
17 electrophotographic apparatus constructed and operative in
18 accordance with a preferred embodiment of the present
19 invention;

20 Fig. 2 is a simplified sectional illustration of
21 electrophotographic apparatus constructed and operative in
22 accordance with another preferred embodiment of the present
23 invention;

24 Fig. 3 is a simplified sectional illustration of
25 electrophotographic apparatus constructed and operative in
26 accordance with yet another preferred embodiment of the
27 present invention;

28 Fig. 4 is a simplified sectional illustration of a
29 electrophotographic apparatus constructed and operative in
30 accordance with yet another preferred embodiment of the
31 present invention;

32 Fig. 5 is a simplified sectional illustration of
33 electrophotographic apparatus constructed and operative in
34 accordance with yet another preferred embodiment of the
35 present invention;

36 Fig. 6 is a simplified sectional illustration of
37 electrophotographic apparatus constructed and operative in
38 accordance with yet another preferred embodiment of the

1 present invention; and

2 Fig. 7 is a graphical illustration of the temperature
3 variation along a low thermal mass intermediate transfer
4 member in an arrangement such as that illustrated in Fig. 6.

5 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

6 Reference is now made to Fig. 1 which illustrates
7 electrophotographic imaging apparatus constructed and
8 operative in accordance with a preferred embodiment of the
9 present invention. This and other embodiments of the
10 invention are described in the context of liquid developer
11 systems with negatively charged toner particles and
12 positively charged photoreceptors. Such systems operate in a
13 "write-white" mode, for which areas which are not to be toned
14 are exposed to light. The invention may be useful for other
15 combinations of toner charge, photoreceptor charge as well as
16 for other writing systems, such as "write-black" systems.

17 The apparatus of the invention is described using a
18 liquid developer system. In accordance with a preferred
19 embodiment of the invention the liquid developer of Example 1
20 of U. S. Patent 4,794,651 can be used, but other suitable
21 developers may be used in the practice of the invention.
22 Especially useful are liquid developers comprising toner
23 particles which solvate the carrier liquid of the developer
24 at elevated temperatures, above room temperature.

25 As in conventional electrophotographic systems, the
26 apparatus of Fig. 1 comprises a drum 10 arranged for rotation
27 about an axle 12 in a direction generally indicated by arrow
28 14. Drum 10 is formed with a cylindrical photoreceptor
29 surface 16.

30 A corona discharge device 18 is operative to generally
31 uniformly charge photoreceptor surface 16 with a positive
32 charge. Continued rotation of drum 10 brings charged
33 photoreceptor surface 16 into image receiving relationship
34 with an exposure unit including a lens 20. Lens 20, focuses a
35 desired image, which may be laser generated, onto charged
36 photoreceptor surface 16, selectively discharging the
37 photoreceptor surface, thus producing an electrostatic
38 latent image thereon.

1 Continued rotation of drum 10 brings charged
2 photoreceptor surface 16 bearing the electrostatic latent
3 image into operative association with a development unit 22,
4 operative to apply a liquid developer to develop the
5 electrostatic latent image. For multicolor copying or
6 printing, the development unit 22 can, for example, comprise
7 a plurality of developers, one for each color, which are
8 selectively engaged with the photoreceptor, as described, for
9 example, in U.S. Patent 4,690,539, which is incorporated
10 herein by reference, or a single development station where
11 the liquid toner is changed between colors, or any other
12 suitable development system. In general this development
13 process takes place at a relatively low temperature, namely
14 approximately the temperature of the environment of the
15 system.

16 In accordance with a preferred embodiment of the
17 invention, following application of toner thereto,
18 photoreceptor surface 16 passes a typically positively
19 charged rotating roller 26, preferably rotating in a
20 direction indicated by an arrow 28. Roller 26 functions as a
21 metering roller and reduces the thickness of liquid on
22 photoreceptor surface 16. Typically the spatial separation of
23 roller 26 from photoreceptor surface 16 is about 50 microns.

24 Preferably the voltage on roller 26 is intermediate the
25 voltages of the latent image areas and of the background
26 areas on the photoreceptor surface. Typical voltages are:
27 roller 26: +200V, background area: +50V and latent image
28 areas: up to about +1000V.

29 Liquid which passes roller 26 should be relatively free
30 of pigmented particles except in the region of the latent
31 image.

32 Downstream of roller 26 there is preferably provided a
33 rigidizing roller 30. Rigidizing roller 30 is preferably
34 formed of a resilient polymeric material, for example a
35 slightly conductive resilient polymeric material as described
36 in either or both of U.S. Patents 3,959,574 and 3,863,603
37 the disclosures of which are incorporated herein by
38 reference. Roller 30 is preferably resiliently urged against

1 photoconductive surface 16.

2 In a preferred embodiment of the invention, a n
3 electrically biased squeegee roller is used as roller 30.
4 Roller 30 is negatively charged to a potential of at least
5 several hundred and up to 2000 volts with the same sign as
6 the charge on the pigmented toner particles, so that it
7 repels similarly charged pigmented particles and causes them
8 to more closely approach the image areas of the photoreceptor
9 surface 16, thus compressing and rigidizing the image.

10 Downstream of rigidizing roller 30 there is provided an
11 intermediate transfer member 40, which rotates in a direction
12 opposite to that of photoreceptor surface 16, as shown by
13 arrow 41, providing zero relative motion between their
14 respective surfaces at the point of propinquity. Intermediate
15 transfer member 40 is operative for receiving the toner image
16 from photoreceptor surface 16 and for transferring the toner
17 image to a receiving substrate 42, such as paper. Disposed
18 internally of intermediate transfer member 40 there may be
19 provided a heater 46, to heat intermediate transfer member
20 40.

21 Various types of intermediate transfer members are known
22 and are described, for example in U.S. Patent 4,684,238, PCT
23 Publication WO 90/04216 and U. S. Patent 4,974,027 the
24 disclosures of all of which are incorporated herein by
25 reference.

26 Following the transfer of the toner image to
27 intermediate transfer member 40, photoreceptor surface 16
28 engages a cleaning station 49. This station may be any
29 conventional cleaning station, comprising a cleaning roller
30 50 which may comprise a suitable resilient material such as
31 foam polyethylene or neoprene. Cleaning roller 50 may be
32 wetted by clean lubricating cleaning liquid, which preferably
33 comprises liquid developer from which all or nearly all of
34 the toner particles have been removed. Cleaning roller 50 is
35 driven so that its surface moves opposite to surface 16 at
36 their nip, to provide scrubbing action for removal of
37 residual particles and carrier liquid from photoreceptor
38 surface 16. A scraper 56 completes the removal of any

1 residual toner which may not have been removed by cleaning
2 station 49.

3 A lamp 58 completes the cycle by removing any residual
4 charge, characteristic of the previous image, from
5 semiconductor surface 16.

6 Transfer of the image to intermediate transfer member 40
7 is preferably aided by providing electrification of
8 intermediate transfer member 40 to a voltage opposite that of
9 the charged particles, thereby causing transfer by
10 electrophoresis. It has been found by the inventors, that, at
11 least for the preferred developer, raising the temperature of
12 the developed toner image to a temperature higher than the
13 development temperature and room temperature aids this first
14 transfer, even when the transfer is by electrophoresis.

15 Subsequent final transfer of the image from intermediate
16 transfer member 40 to substrate 42 is preferably aided by
17 heat and pressure. A higher temperature than that used for
18 first transfer is preferably utilized for this subsequent
19 final transfer, in accordance with the present invention.

20 In the prior art a liquid toner image was first
21 transferred to an intermediate transfer member. The toner
22 image was heated during the interval between first and second
23 transfer so as to aid in final transfer.

24 In the present invention the preferred first transfer
25 step, i.e., the transfer of the liquid toner image to the
26 intermediate transfer member includes the heating of the
27 image either before or during first transfer. The preferred
28 final transfer step, i.e., the transfer of the liquid toner
29 image to the final substrate, includes the further heating of
30 the image before and/or during second transfer. This further
31 heating can be achieved by heating the image on intermediate
32 transfer member 40, for example by heat transfer from
33 intermediate transfer member 40 during the interval between
34 first and final transfer and/or by external heating of the
35 image. Preferably the image is heated to a temperature at
36 which it solvates liquid to form a single phase, without
37 evaporating substantial amounts of liquid carrier.
38 Alternatively or additionally the further heating can be

1 achieved by conduction heating of the image from the final
2 substrate during final transfer.

3 These preferred first and second transfer steps improve
4 the quality of the image on the final substrate both for
5 single color and for multi-color images.

6 For multicolor systems it is useful to sequentially
7 transfer the separate colors to intermediate transfer member
8 40 in alignment with and generally superimposed and in
9 registration with each other and then to transfer them
10 together to paper or other substrate 42. It has then been
11 found that for this configuration, there is a tendency for
12 the heated images previously transferred to the intermediate
13 transfer member at a lower temperature, to transfer back, in
14 whole or in part, to photoreceptor surface 16, when the
15 previously transferred image returns to the point of first
16 transfer.

17 The embodiments of the invention described herein
18 provide improved first and final transfer and for multicolor
19 systems can solve the back transfer problem.

20 In general, some of the embodiments of the invention are
21 characterized in that photoreceptor 16 is at a first,
22 relatively low temperature; intermediate transfer member 40
23 is at a second, somewhat higher temperature, to provide for
24 improved first transfer; and final substrate 42 is at a
25 third, even higher temperature to provide for good transfer
26 from intermediate transfer member 40 to substrate 42.

27 Alternatively or additionally, some of the embodiments
28 can be characterized in that, when a toner image is
29 transferred from photoreceptor surface 16 to intermediate
30 transfer member 40, and then to final substrate 42, the toner
31 image is hotter during transfer to the intermediate transfer
32 member than it was on the photoreceptor surface and the image
33 is hotter when it is transferred to the final substrate, than
34 during the earlier transfer.

35 Alternatively or additionally, some of the embodiments
36 can be characterized in that, when multiple toner images are
37 transferred sequentially from photoreceptor surface 16 to
38 intermediate transfer member 40, and then to final substrate

1 42 as a group, the composite, multicolor toner image is
2 hotter when it is transferred to the final substrate than
3 during any contact of earlier transferred images with the
4 photoreceptor.

5 One embodiment of the invention can be characterized in
6 that the image is transferred from a photoreceptor surface,
7 at a first relatively low temperature to a first intermediate
8 transfer member at a second intermediate temperature. The
9 image is then transferred to a second intermediate transfer
10 member. Final transfer takes place from the second
11 intermediate transfer member to the final substrate at a
12 third, higher temperature. Preferably, the image temperature
13 during first transfer is higher than that of that portion of
14 the photoreceptor surface not in contact with the
15 intermediate transfer member.

16 Returning now to Fig. 1, intermediate transfer member 40
17 is heated to a temperature sufficient to enhance the
18 electrophoretic transfer of toner particles from
19 photoreceptor surface 16 to intermediate transfer member 40.
20 The image is heated during transfer to intermediate transfer
21 member 40, and the heating continues while the image is on
22 intermediate transfer member 40 until the image is at the
23 temperature of intermediate transfer member 40. Rotation of
24 intermediate transfer member 40 brings the heated
25 intermediate transfer member 40 into image transfer
26 relationship with a final substrate 42, which is pressed
27 against the intermediate transfer member by a heated backing
28 roller 43. Heated backing roller 43 heats the paper and
29 thereby heats the image in contact therewith by conduction
30 from the paper, to a sufficient degree to ensure that
31 complete or nearly complete final transfer of the image to
32 the substrate, by heat and pressure, takes place.

33 While the invention has been described in a
34 monochromatic version, where it gives improved transfer from
35 the photoreceptor to the intermediate transfer member and
36 from the intermediate transfer member to the final substrate,
37 the invention is particularly useful in a multicolor system,
38 wherein images of different colors are sequentially formed on

1 photoreceptor surface 16, and transferred one by one in
2 mutual alignment to image transfer member 40 prior to a
3 single transfer of all of the images, which form a multicolor
4 image, to final substrate 42.

5 Final substrate 42 is brought into transfer engagement
6 with intermediate transfer member 40 only when all of the
7 colors have been transferred to intermediate transfer member
8 40, for final transfer of the multicolor image to substrate
9 42.

10 As noted above, it is appreciated that during first
11 transfer of subsequent images from photoreceptor surface 16
12 to image transfer member 40, earlier transferred images
13 return to the region of first transfer. Any back transfer of
14 previously transferred images to photoreceptor surface 16
15 will result in undesirable artifacts in the final printed
16 image.

17 Generally if the intermediate transfer member is heated
18 to a temperature which is useful for good final transfer,
19 then there is a tendency for the image to back transfer to
20 the photoreceptor.

21 The arrangement of Fig. 1, with proper choice of
22 temperatures for intermediate transfer member 40 at first
23 transfer, and for final substrate 42 and the image at second
24 transfer in accordance with the present invention,
25 substantially eliminates the problem of back transfer to
26 photoreceptor surface 16, by keeping the image temperature,
27 when the image on the intermediate transfer member returns to
28 the photoreceptor, low enough so that it is not tacky enough
29 to stick to the photoreceptor.

30 Fig. 2 shows a second embodiment of the invention in
31 which all of the parts and operation are generally the same
32 as those of the apparatus of Fig. 1, except that heated
33 backing roller 43 is replaced by an unheated backing roller
34 44, and final substrate 42 is preheated by a heating lamp 45.
35 A combination of the embodiments of Figs. 1 and 2 is also
36 useful, whereby paper 42 is pre-heated by lamp 45, and heated
37 roller 43 is used.

38 A third embodiment of the apparatus of the invention is

1 shown in Fig. 3. In this case intermediate transfer member 40
2 is heated to a first, moderate, temperature which is high
3 enough to enhance first transfer, but not so high as to cause
4 substantial back transfer of previously transferred images
5 from intermediate transfer member 40 to photoreceptor surface
6 16. The images are transferred to a second intermediate
7 transfer member 47 which is heated by an internal heater 48
8 to a higher temperature, sufficient to assure good final
9 transfer to final substrate 42.

10 In a preferred embodiment of the invention, intermediate
11 transfer member 40 is maintained at a first voltage
12 (different from the voltage of the photoreceptor surface 16)
13 to enhance transfer of the image thereto from photoreceptor
14 surface 16, and second intermediate transfer member 47 is
15 electrified to a second voltage, different from the first
16 voltage, to enhance transfer of the image thereto from
17 intermediate transfer member 40.

18 Transfer to second intermediate transfer member 41 can
19 occur sequentially for each of the images, or preferably the
20 images are collected on first intermediate transfer member 40
21 and then the multicolor image is transferred as a whole to
22 second intermediate transfer member 47 for final transfer to
23 the final substrate 42.

24 A duplex embodiment of the invention, for printing two
25 sides of a substrate at the same time is shown in Fig. 4. The
26 separate color images which make up the multi-colored image
27 to be printed on a first side of substrate 42 are first
28 transferred sequentially to intermediate transfer member 40
29 and then are transferred, preferably as a group, to second
30 intermediate transfer member 47. Second image transfer member
31 47 is preferably heated to a higher temperature than
32 intermediate transfer member 40. The images to be printed on
33 the other side of the page are subsequently transferred
34 sequentially to intermediate transfer member 40, which is
35 meanwhile kept out of transfer engagement with second
36 intermediate transfer member 47.

37 Final substrate 42 is then passed between intermediate
38 transfer member 40 and second intermediate transfer member

1 47, while pressing the two intermediate transfer members
2 together to effect transfer of the images to both sides of
3 the paper by heat and pressure. It is understood that
4 preferably second intermediate transfer member 47 heats
5 substrate 42 and the image to a suitable temperature to
6 assure good transfer of the image on intermediate transfer
7 member 40 to substrate 42. Alternatively or additionally, the
8 paper may be heated before transfer as described above in
9 connection with Fig. 2.

10 In some preferred embodiments of the invention
11 intermediate transfer member 40 acts to heat the image to a
12 first temperature during first transfer from photoreceptor 16
13 to intermediate transfer member 40, and to heat the image to
14 a second higher temperature before second and final transfer
15 from intermediate transfer member 40 to final substrate 42.

16 Exemplary embodiments include the apparatus shown in
17 Fig. 5. This apparatus is generally the same as the apparatus
18 of Fig. 1, except that a cooling station 60 is operatively
19 associated with intermediate transfer member 40 just before
20 it returns to make contact with photoreceptor surface 16.
21 Intermediate transfer member 40 is cooled at cooling station
22 60 to locally reduce the temperature of intermediate transfer
23 member 40 before and during contact with the image on the
24 photoreceptor. This local cooling allows the liquid toner
25 image to be hotter at the point of final transfer from
26 intermediate transfer member 40 to final substrate 42 than it
27 is at first transfer from photoreceptor surface 16 to
28 intermediate transfer member 40.

29 Cooling station 60 may comprise, for example, apparatus
30 for providing a stream of cool air to the surface of the
31 photoreceptor or a cooled roller in contact with the
32 photoreceptor surface. Either or both cooling systems cool
33 intermediate transfer member 40 to a temperature, higher than
34 room temperature, but lower than the final transfer
35 temperature.

36 In a multicolor system, if a roller cooler is used it is
37 coated with a non-stick coating to avoid transfer of the
38 image from intermediate transfer member 40 to the roller of

1 cooling station 60.

2 Another exemplary embodiment of this type is illustrated
3 in Fig. 6, which is essentially the same as Fig. 8 of WO
4 90/04216 previously referenced. Here an intermediate transfer
5 member 140 is of low heat capacity, and is heated only after
6 first transfer is completed. As shown in Fig. 7, which is the
7 same as Fig. 9 of the above referenced application, the
8 temperature at the first transfer is above room temperature
9 in order to improve first transfer, and the temperature at
10 second transfer is even higher to assure complete or nearly
11 complete second transfer. For a multi-color system the
12 temperatures and heat capacities are selected so that the
13 first transfer takes place at a temperature low enough to
14 avoid back transfer.

15 In the above embodiments, intermediate transfer members
16 40 and 47 have been described as having heaters placed
17 internal to the core to heat each of them to its required
18 temperature. Other methods of heating intermediate transfer
19 members known in the art can also be used in the practice of
20 the invention.

21 Examples

22 Colored liquid developer is prepared in the following
23 manner:

24 Preparation of Black Liquid Developer

25 10 parts by weight of Elvax 5720 (E. I. Du Pont) and 5
26 parts by weight of Isopar L are mixed at low speed in a
27 jacketed double planetary mixer connected to an oil heating
28 unit for one hour, the heating unit being set at 130 degrees
29 C.

30 A mixture of 2.5 parts by weight of Mogul L carbon black
31 (Cabot) and 5 parts by weight of Isopar L are then added to
32 the mix in the double planetary mixer and the resultant
33 mixture is further mixed for one hour at high speed. 20 parts
34 by weight of Isopar L preheated to 110 degrees C are added to
35 the mixer and mixing is continued at high speed for one hour.
36 The heating unit is then disconnected and mixing is continued
37 until the temperature of the mixture drops to 40 degrees C.

38 The resulting mixture is transferred to an S-1 attritor

1 device equipped with 3/16 inch carbon steel media, diluted
2 with Isopar L to a 16% solids ratio and ground without
3 cooling until the temperature rises to about 60 degrees C.
4 Cooling, which reduces the temperature to about 30 degrees is
5 then commenced and grinding is continued for a total of 24
6 hours. The mixture is removed from the device and diluted
7 with Isopar L to 1.5% by weight solids concentration. The
8 particles in the resultant toner concentrate have an average
9 diameter of 2.5 microns.

10 Charge director as known in the art, is added to give
11 the final liquid developer. In a preferred embodiment of the
12 invention the charge director of Example 1 of PCT publication
13 WO 90/14617 the disclosure of which is incorporated herein by
14 reference, is added to give the final liquid developer.

15 Preparation of Colored Developer

16 10 parts by weight of Elvax 5720 (E. I. Du Pont) and 5
17 parts by weight of Isopar L are mixed at low speed in a
18 jacketed double planetary mixer connected to an oil heating
19 unit for one hour, the heating unit being set at 130 degrees
20 C.

21 Pre-heated Isopar L is then added to reduce the solids
22 concentration to preferably 35% and mixing is continued at
23 high speed for one hour. The heating unit is then
24 disconnected and mixing is continued until the temperature of
25 the mixture drops to 40 degrees C.

26 The mixture is then transferred to an S-1 attritor
27 device equipped with 3/16 inch carbon steel media and pigment
28 is added to the material in the attritor. The mixture is
29 diluted with Isopar L to about a 12-16% solids ratio,
30 depending on the viscosity of the material and is ground
31 without cooling until the temperature rises to about 60
32 degrees C. Cooling, which reduces the temperature to about 30
33 degrees, is then commenced and grinding is continued for a
34 total of 24 hours. The mixture is removed from the device
35 and diluted with Isopar L to 1.5% by weight solids
36 concentration. The particles in the resultant toner
37 concentrate had an average diameter of 2.5 microns.

38 Charge director as known in the art, is added to give

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1 the final liquid developer. In a preferred embodiment of the
2 invention the charge director of Example 1 the above
3 referenced PCT publication WO 90/14617 is added to give the
4 final liquid developer.

5 Appropriate colored pigments known in the art of liquid
6 developer manufacture, for example the list given in U. S.
7 Patent 4,794,561 can be used. Other suitable pigments are
8 Sico Fast Yellow D1350 (BASF), Lithol Rubin D4576 (BASF),
9 Lyonol Blue FG7351 (TOYO) and Lyonol Yellow 7G1310 (TOYO). in
10 amounts and combinations depending on the color and intensity
11 required. Optionally, Aluminum Stearate can be added in small
12 amounts. For pigments which are discolored by steel, other
13 grinding media such as zirconia may be used.

14 These developers are used to form the individual color
15 liquid toner images on photoreceptor surface 16 which
16 comprise a relatively high concentration of toner particles
17 in carrier liquid.

18 Photoreceptor surface 16 is preferably formed of
19 selenium. Intermediate transfer member 40 is preferably
20 formed of a cylindrical aluminum core coated with a 1 mm
21 thick layer of very soft polyurethane having a hardness of
22 20-25 Shore A. This layer is covered by an offset printing
23 blanket, preferably a KYNIO AIRTACK offset blanket, which is
24 much harder than the polyurethane. A thin conducting layer of
25 conducting acrylic covers this layer and is covered in turn
26 by a 0.1 mm layer of polyurethane of shore A Hardness 20.
27 This layer is overcoated by a thin layer of Syl-Off type 291
28 or 294 silicone release coating.

29 Liquid developer prepared in accordance with the method
30 described above is used in the equipment of Fig. 1.
31 Preferably the temperature of the intermediate transfer layer
32 should be less than about 50 degrees C. For temperatures
33 greater than about 50 degrees, there is a tendency for the
34 previously transferred colors to back transfer to
35 photoreceptor surface 16. Heating intermediate transfer
36 member 40 improves image transfer to intermediate transfer
37 member 40. Intermediate transfer member 40 is preferably
38 heated to a temperature somewhat below that at which back

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1 transfer begins to occur.

2 It is believed that the improvement in first transfer
3 when the intermediate transfer member is heated may be a
4 consequence of partial solvation of carrier liquid by the
5 pigmented toner particles in the image.

6 One characteristic of the liquid developers preferred in
7 the practice of this invention is that the pigmented toner
8 particles contained therein solvate the carrier liquid at
9 elevated temperatures. It is believed that there is a partial
10 solvation of the carrier liquid in the toner particles during
11 first transfer to heated intermediate transfer member 40
12 which may cause the particles to partially coalesce and form
13 a film during first transfer. Coalesced toner is believed to
14 transfer better than uncoalesced toner particles.

15 Furthermore, when the toner material solvates some of
16 the carrier liquid, the toner particles separate from the
17 unsolvated carrier liquid. It is believed that this separated
18 carrier liquid forms a film between the toner image and the
19 photoreceptor which reduces the adhesion of the image to the
20 photoreceptor, aiding complete transfer of the image to the
21 intermediate transfer member.

22 It is to be understood that the heating of the image
23 before and/or during final transfer insures the complete or
24 nearly complete transfer of the image from the intermediate
25 transfer member to the final substrate. Where this image
26 heating comes solely by conduction from the paper, it has
27 been found experimentally that the paper should be at a
28 temperature of at least about 70 degrees C. Higher
29 temperatures such as 80 or 90 degrees can also be used, but
30 substantially lower temperatures do not tackify the image
31 enough to assure complete transfer from intermediate transfer
32 member 40 to paper 42.

33 The precise temperatures used for particular
34 configurations and combinations are a function of the
35 material properties of the toner particles and the carrier
36 liquid as well as of the quality of the release layer on the
37 intermediate transfer member. Back transfer occurs due to the
38 tackiness of the image, but is also influenced by the

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1 relative adhesion of the image to the release layer on the
2 intermediate transfer member and to the photoreceptor. It
3 would be possible to increase the temperature of the
4 intermediate transfer member if the release properties of the
5 surface of the intermediate transfer member were poorer. This
6 however would also result in poorer transfer to the final
7 substrate.

8 In particular representative, operating examples the
9 following temperatures are used. In a first example, which is
10 used for the transfer of single color images, the
11 intermediate transfer member is heated to a surface
12 temperature of 100 degrees C and the paper is not heated.
13 Calculations show that the image is at a temperature of 52 to
14 63 degrees C during first transfer. During the interval
15 between first and second transfer the image temperature rises
16 to the intermediate transfer member's temperature of 100
17 degrees C, and the image is cooled during second, final
18 transfer to paper to a temperature of 73 to 78 degrees C.

19 In a second, representative, operating example for
20 sequential transfer of multiple images to the intermediate
21 transfer member, the intermediate transfer member is heated
22 to 50 degrees C and backing roller 43 is heated to 120
23 degrees C. The image temperature on first transfer is
24 approximately 43 degrees C and on second transfer it is 75 to
25 78 degrees C.

26 The temperatures shown in figure 7 are also
27 representative of values suitable for single image transfer.
28 For multi-image transfer to intermediate transfer member 140,
29 the first transfer temperature must be low enough to assure
30 that no back transfer takes place.

31 It will be understood that certain features and sub-
32 combinations of the invention are useful, and may be employed
33 without other features and sub-combinations. It is noted that
34 various changes may be made in details within the scope of
35 the claims without departing from the spirit of the
36 invention. It is therefor to be understood that the
37 invention is not to be limited to the specific details shown
38 and described.

CLAIMS

- 1
2 1. Imaging apparatus for printing an image on a substrate
3 from a latent image formed on a latent image bearing surface
4 comprising:
5 developing means for developing said latent image with a
6 liquid developer to form a developed liquid toner image;
7 a first intermediate transfer member;
8 first transfer means for transferring said developed
9 image from said latent image bearing surface to said first
10 intermediate transfer member at a first transfer region;
11 a second intermediate transfer member;
12 second transfer means for transferring said developed
13 image from said first image transfer member to said second
14 intermediate transfer member at a second transfer region; and
15 third transfer means for transferring said developed
16 image from said second intermediate transfer member to said
17 substrate.
18
- 19 2. Imaging apparatus according to claim 1 and including:
20 heating means for heating said developed liquid toner
21 image to a first temperature higher than room temperature at
22 said first transfer region and to a second temperature higher
23 than said first temperature at said second transfer region.
24
- 25 3. Imaging apparatus according to claim 1 and including:
26 intermediate transfer member heating means for heating
27 said first intermediate transfer member to a first
28 temperature and for heating said second intermediate transfer
29 member to a second temperature higher than said first
30 temperature.
31
- 32 4. Apparatus according to claim 2 or claim 3 wherein:
33 liquid toner image transfer from said image bearing
34 surface is enhanced at temperatures above a first given
35 temperature;
36 liquid toner image transfer to said final substrate is
37 enhanced at temperatures above a second given temperature,
38 higher than said first given temperature; and

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1 undesirable image transfer from said intermediate
2 transfer member to said image bearing surface is increased
3 at temperatures above a third given temperature, higher than
4 said first given temperature and lower than said second given
5 temperature, and

6 wherein said first temperature is above said first
7 given temperature and below said third given temperature, and
8 wherein said second temperature is above said second given
9 temperature.

10

11 5. Imaging apparatus according to any of the preceding
12 claims and also including first voltage means for maintaining
13 said first intermediate transfer member at a first voltage.

14

15 6. Imaging apparatus according to claim 5 wherein at least a
16 portion of said latent image bearing surface is at a second
17 voltage and said first voltage is different from said second
18 voltage.

19

20 7. Imaging apparatus according to claim 5 or claim 6 and
21 also including second voltage means for maintaining said
22 second intermediate transfer member at a third voltage.

23

24 8. Apparatus according to any of the preceding claims
25 wherein:

26 said developing means is operative for developing a
27 latent image to form a second developed liquid toner image
28 thereon after transfer of said developed liquid toner image
29 therefrom to said intermediate transfer member; and

30 said first transfer means is operative to transfer said
31 second liquid toner image to said first intermediate transfer
32 member, without substantial back-transfer of said first image
33 to said image bearing member, to form a composite image.

34

35 9. Apparatus according to claim 8 wherein:

36 said second transfer means is operative to transfer said
37 composite image to said second intermediate transfer member.

38

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1 10. Apparatus according to any of the preceding claims
2 wherein:

3 said developing means is operative to develop a different
4 latent image to form a different liquid toner image on said
5 image bearing surface; and

6 said first transfer means is operative to transfer said
7 different liquid toner image to said first intermediate
8 transfer member subsequent to transfer of said developed
9 liquid toner image therefrom to said second image transfer
10 member.

11

12 11. Apparatus according to claim 10 wherein said third
13 transfer means comprises:

14 means for supplying a substrate to said second transfer
15 region; and

16 means for urging said first and second transfer members
17 against each other whereby said developed liquid toner image
18 is transferred to one side of said substrate and said
19 different liquid toner image is transferred to the other side
20 of said substrate.

21

22 12. Imaging apparatus for printing an image from a latent
23 image formed on a latent image bearing surface comprising:

24 developing means for developing said latent image with a
25 liquid developer to form a developed liquid toner image;

26 a heated intermediate transfer member for receiving said
27 developed image from said latent image bearing surface at a
28 first transfer region, for subsequent transfer to a final
29 substrate at a second transfer region; and

30 cooling means for cooling a portion of said intermediate
31 transfer member prior to transfer of a portion of said
32 developed image to said cooled portion of said intermediate
33 transfer member.

34

35 13. Apparatus according to claim 12 wherein:

36 liquid toner image transfer from said image bearing
37 surface is enhanced at temperatures above a first given
38 temperature;

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1 liquid toner image transfer to said final substrate is
2 enhanced at temperatures above a second given temperature,
3 higher than said first given temperature; and

4 undesirable image transfer from said intermediate
5 transfer member to said image bearing surface is increased
6 at temperatures above a third given temperature, higher than
7 said first given temperature and lower than said second given
8 temperature, and

9 wherein said intermediate transfer member is heated
10 to a temperature above said second temperature at said second
11 transfer region and said cooling means is operative to cool
12 said intermediate transfer member to a temperature above said
13 first temperature and below said third temperature at said
14 first transfer region.

15

16 14. Apparatus according to claim 12 or claim 13 wherein:

17 said developing means is operative for developing a
18 latent image to form a second developed liquid toner image
19 thereon after transfer of said developed liquid toner image
20 therefrom to said intermediate transfer member; and

21 said intermediate transfer member and said cooling means
22 are operative to transfer said second developed liquid toner
23 image to said intermediate transfer member, without
24 substantial back-transfer of said first liquid toner image to
25 said image bearing member, to form a composite image.

26

27 15. Imaging apparatus for printing an image on a substrate
28 from a latent image formed on a latent image bearing surface
29 comprising:

30 developing means for developing said latent image with a
31 liquid developer to form a developed liquid toner image;

32 an intermediate transfer member heated to a first
33 temperature;

34 first transfer means for transferring said developed
35 image from said latent image bearing surface to said
36 intermediate transfer member at a first transfer region;

37 second transfer means for transferring said developed
38 image from said intermediate transfer member to said

1 substrate said second transfer means comprising:

2 means for heating said substrate to a second
3 temperature higher than said first temperature.

4

5 16. Apparatus according to claim 15 wherein said means for
6 heating comprises a heating backing roller operative to apply
7 heat and pressure to said image during said second transfer.

8

9 17. Apparatus according to claim 15 or claim 16 wherein:

10 said developing means is operative for developing a
11 latent image to form a second developed liquid toner image
12 thereon after transfer of said developed liquid toner image
13 therefrom to said ITM; and

14 said first transfer means is operative to transfer said
15 second developed liquid toner image to said intermediate
16 transfer member, without substantial back-transfer of said
17 developed liquid toner image to said image bearing member, to
18 form a composite image.

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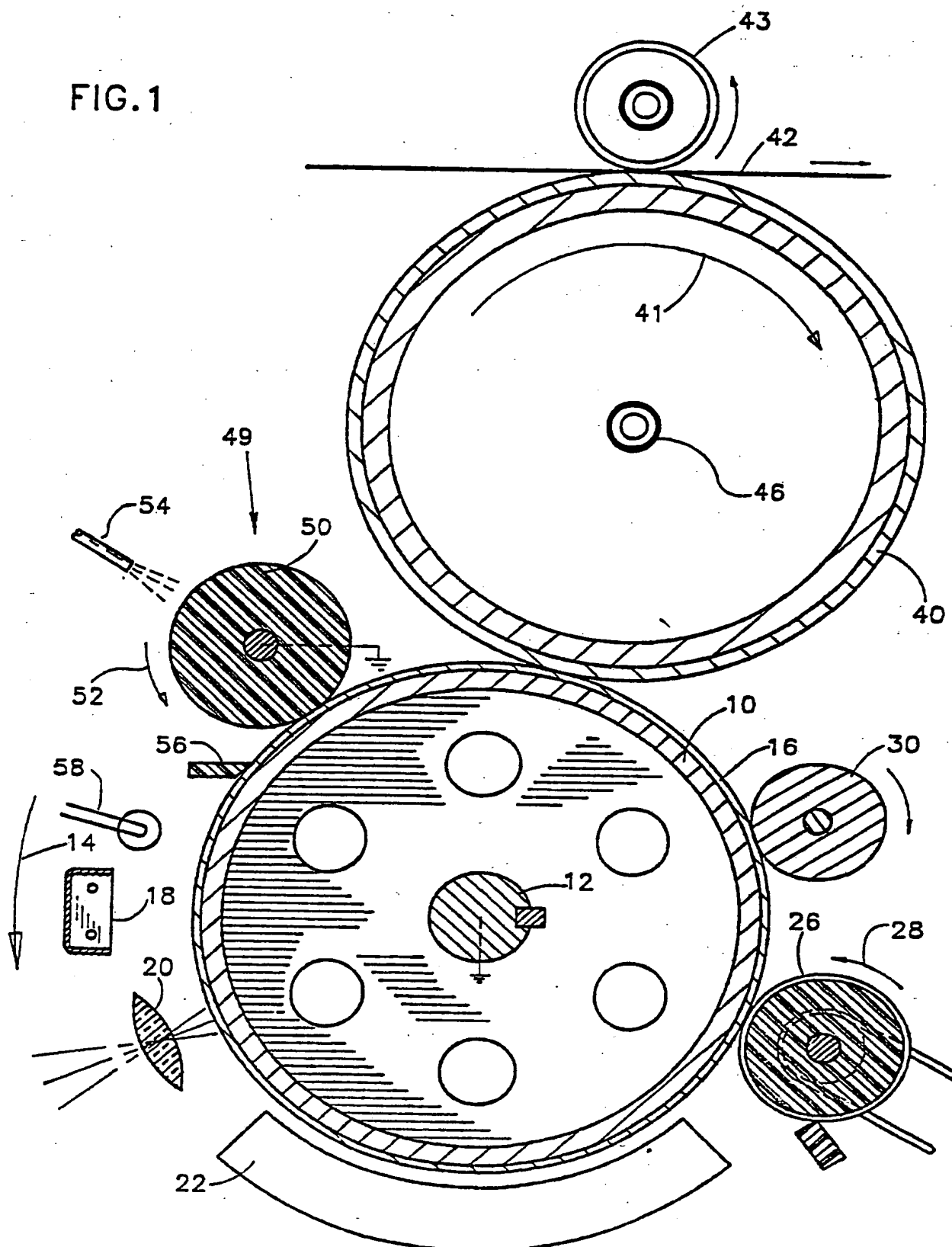
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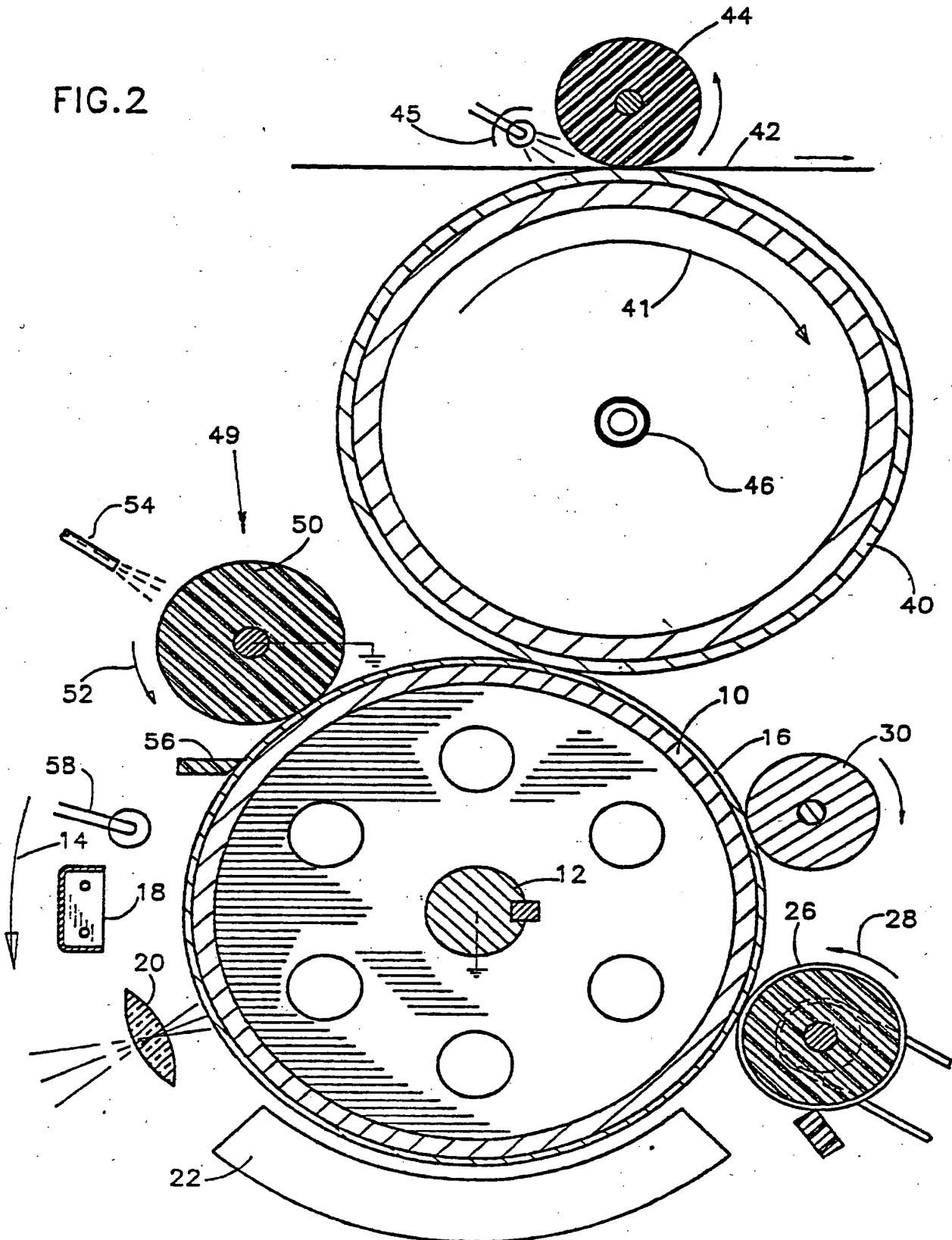
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FIG. 1



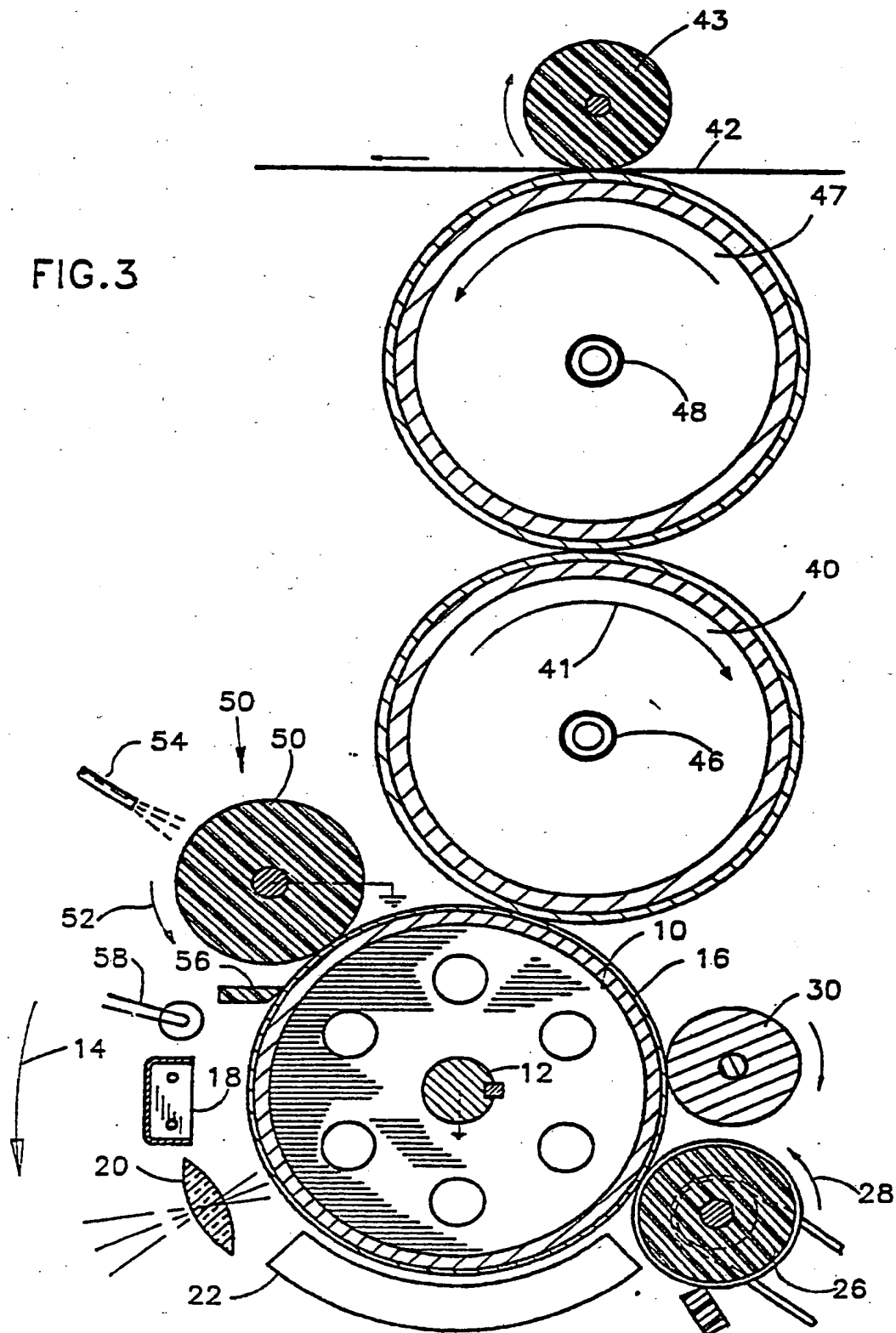
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FIG.2



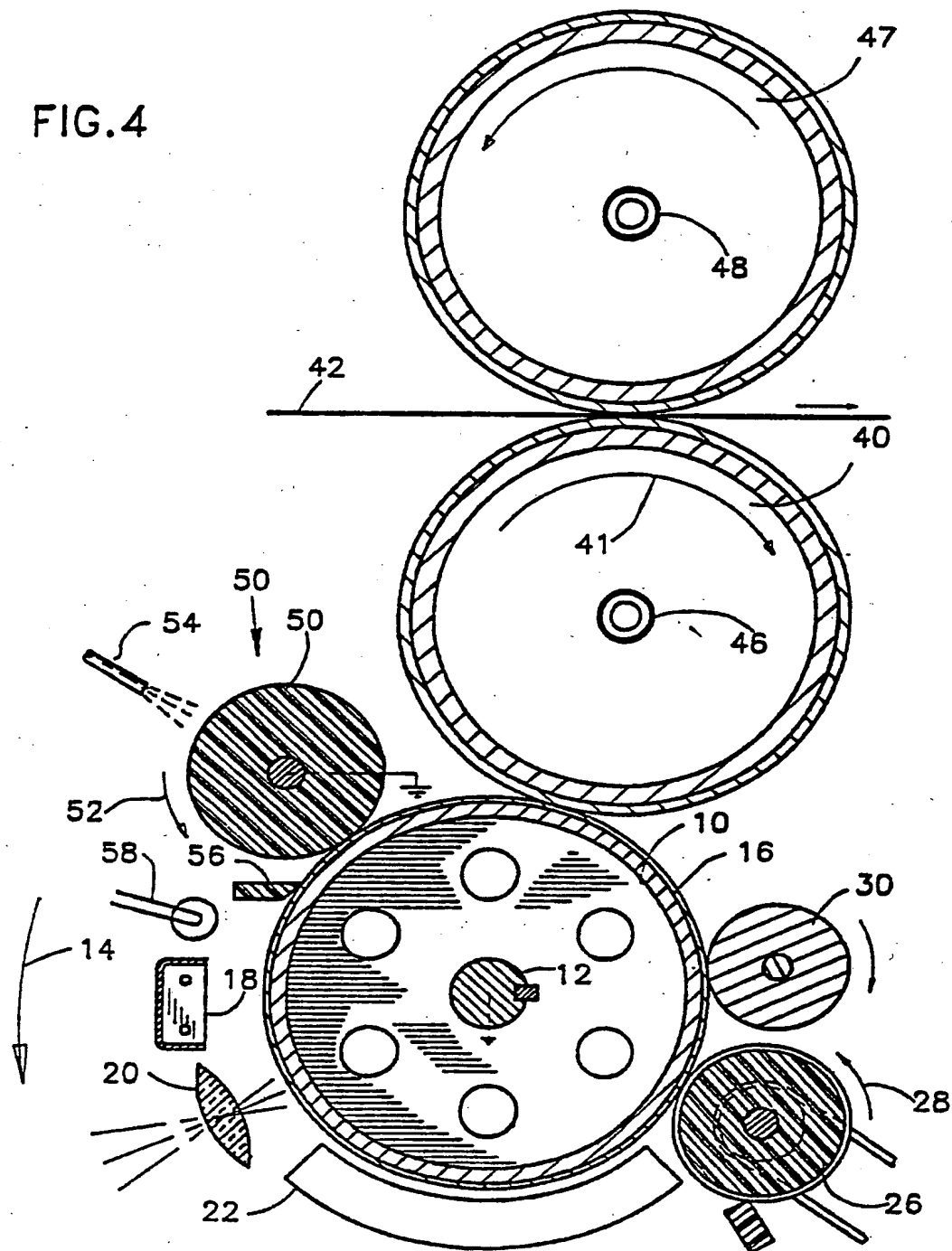
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FIG. 3



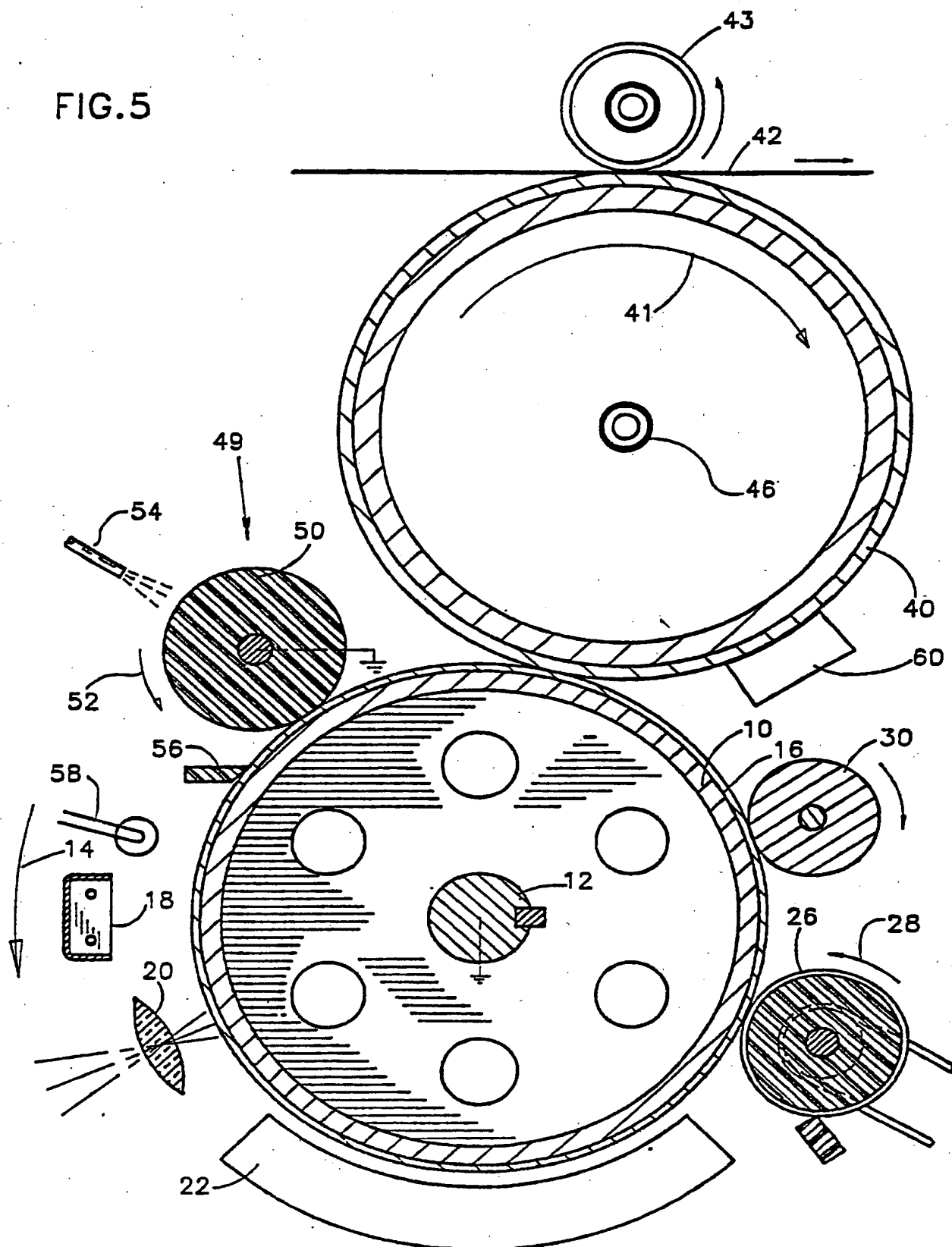
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FIG. 4



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FIG. 5



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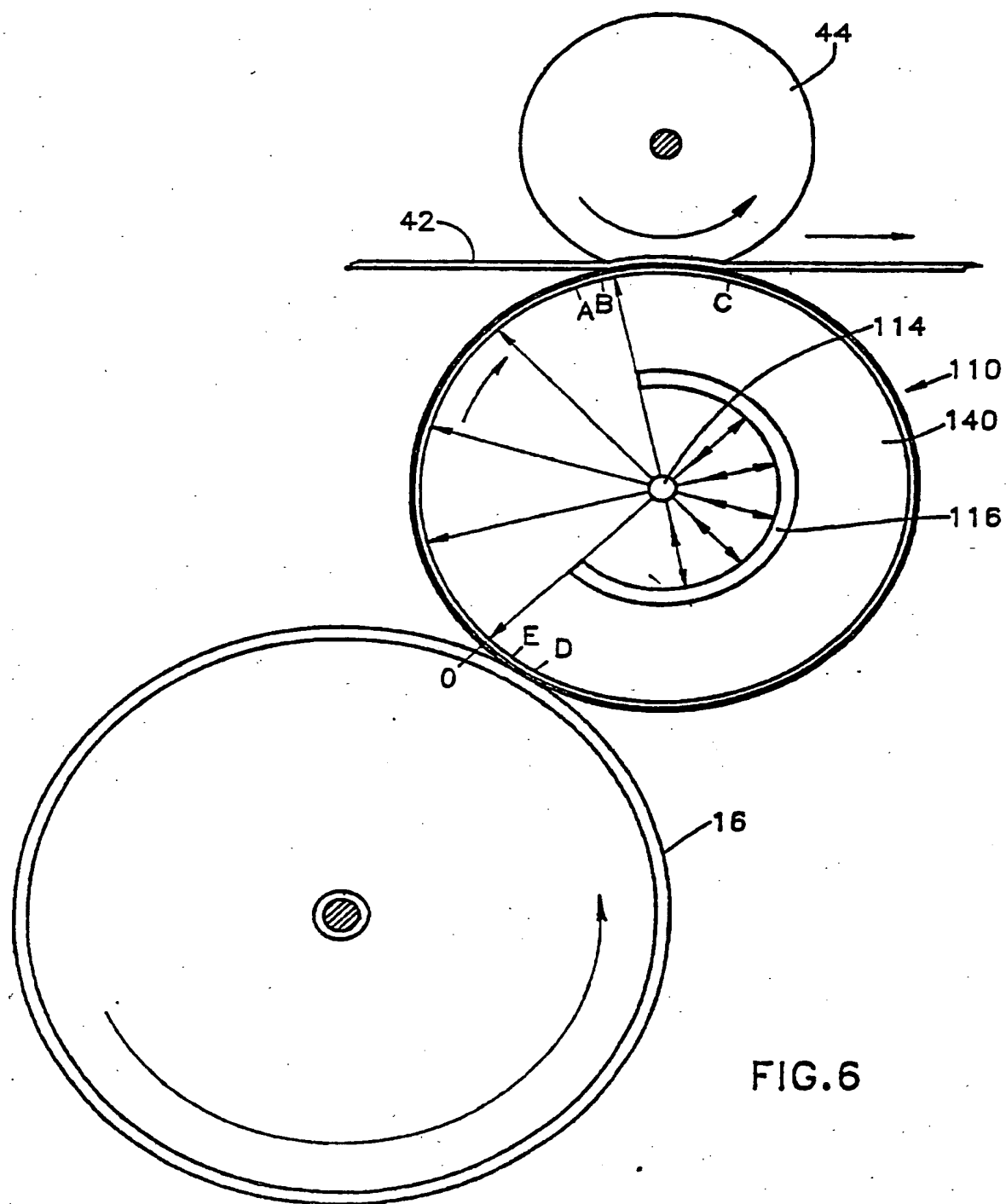
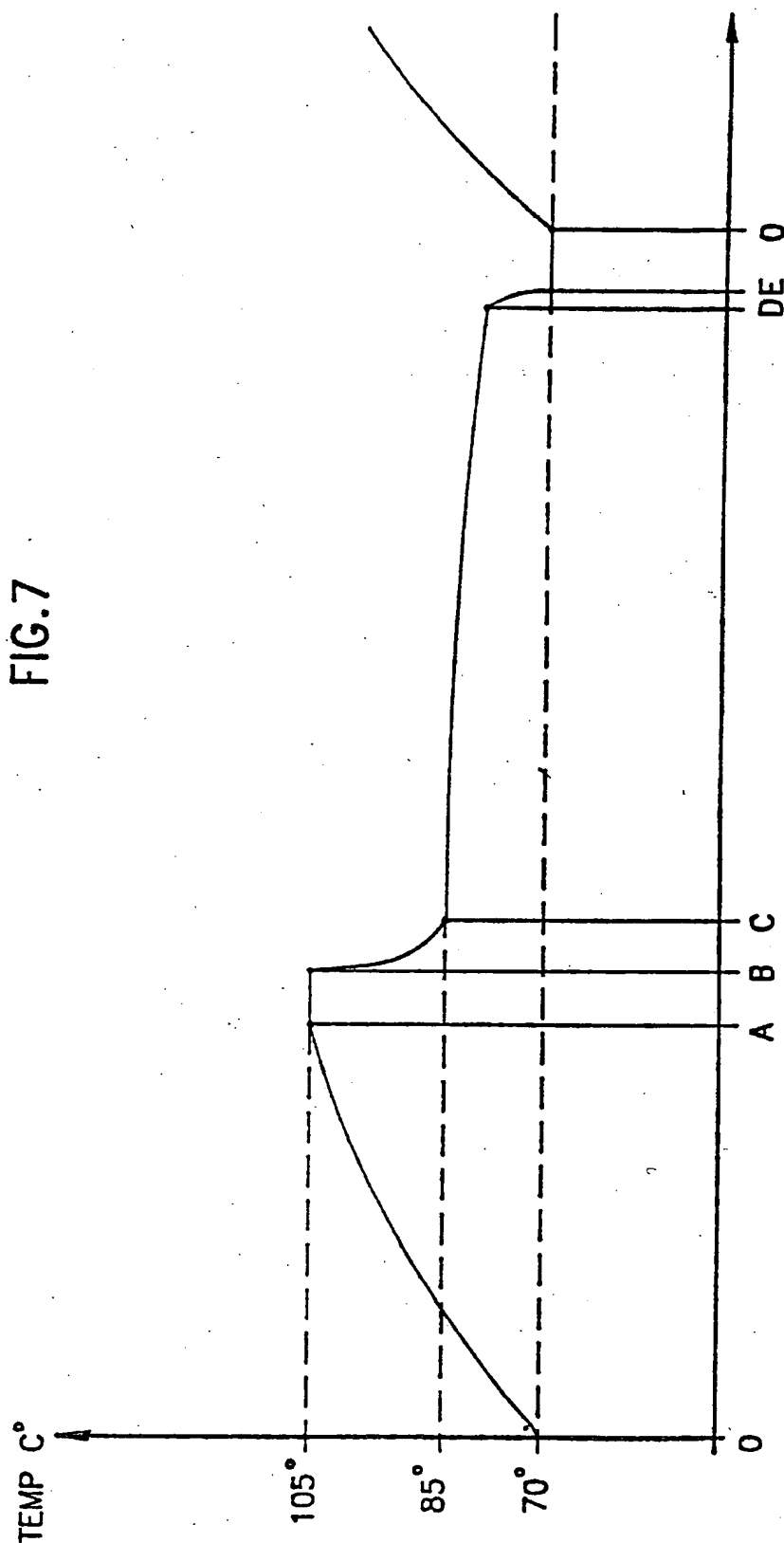


FIG. 7

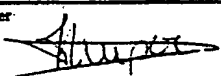


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INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 90/00182

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.C1.5 G 03 G 15/16 G 03 G 15/01		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.C1.5	G 03 G 15/16 G 03 G 15/01	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	Patent Abstracts of Japan, volume 11, no. 358 (P-639)[2805], 21 November 1987, & JP, A, 62134674 (CANON INC.) 17 June 1987 ---	1
X	Patent Abstracts of Japan, volume 12, no. 112 (P-687)[2959], 9 April 1988, & JP, A, 62240987 (CANON INC.) 21 October 1987 ---	1-3
X	Patent Abstracts of Japan, volume 6, no. 59 (P-110)[937], 16 April 1982, & JP, A, 572048 (RICOH K.K.) 7 January 1982 ---	1
A	WO,A,9004216 (SPECTRUM SCIENCES B.V.) 19 April 1990, see page 11, lines 3-15; page 24, line 9 - page 25, line 4; figures 1,8,9 (cited in the application) --- -/-	1-4,8, 10,11
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
26-07-1991		06 DEC 1991
International Searching Authority		Signature of Authorized Officer
EUROPEAN PATENT OFFICE		 Mme N. KUIPER

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	EP,A,0147341 (RHONE-POULENC SYSTEMES) 3 July 1985, see page 10, line 33 - page 11, line 22; figure 1 ---	1,5-7
A	Patent Abstracts of Japan, volume 10, no. 300 (P-506)[2356], 14 October 1986, & JP, A, 61117582 (KONISHIROKU PHOTO IND. CO. LTD) 4 June 1986 ---	1,8-11
A	US,A,3847478 (YOUNG) 12 November 1974, see abstract; figure 1 (cited in the application) -----	1,5-11

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATION WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This International search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim numbers _____ because they relate to subject matter not required to be searched by this Authority, namely: _____
2. ☐ Claim numbers _____ because they relate to parts of the International application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically: _____
3. ☐ Claim numbers _____ because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This International Searching Authority found multiple inventions in this International application as follows:

1. Claims 1-11: Printing apparatus using two intermediate transfer members
2. Claims 12-17: Temperature control of unique intermediate transfer member in printing apparatus

1. ☐ As all required additional search fees were timely paid by the applicant, this International search report covers all searchable claims of the International application
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the International application for which fees were paid, specifically claims: _____
3. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers: 1-11
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

NL 9000182
SA 42910

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 21/11/91
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A- 9004216	19-04-90	EP-A- 0437546	24-07-91
EP-A- 0147341	03-07-85	FR-A- 2557317	28-06-85
		JP-A- 60221773	06-11-85
		US-A- 4607940	26-08-86
US-A- 3847478	12-11-74	CA-A- 1051503	27-03-79
		GB-A- 1474126	18-05-77